UNIT 1

Section A

1) What is a recursion? Compare recursive programs with iterative programs
2) Determine asymptotic order of the function f(n)=2^n+5n+3
3) What do you understand by stable sort?
4) What is an optimization problem?
5) What is the importance of average case analysis of algorithm?
6) Explain Big O notation in brief
7) Write an Insertion sort algorithm
8) What is the importance of average case analysis of algorithm?
9) What do you understand by stable sort?
10) Explain Randomized algorithm in brief
11) What do you mean by best case, average case, and worst case time complexity of an algorithm?
12) Why do we use asymptotic notation in the study of algorithm? Explain in brief various asymptotic notations.
13) What is the running time of heap sort on an array A of length n that is already sorted in increasing order?
14) Solve the recurrence: $T(n)=16T(n/4)+n^2$ by using Master method.
15) What is asymptotic notation? Explain Omega (Ω) notation?
16) Explain searching technique using divide and conquer approach.
17) Explain how algorithms performance is analyzed?
18) What do you mean by Algorithm?
19) Write worst-case and best-case complexity of insertion sort.
20) Describe Activity selection problem.

Section B

1) Show the steps in Heap sort to arrange the following data in non decreasing order {11, 5, 32, 41, 67,21, 4, 27, 64, 11, 5}
2) Write Quick sort algorithm and sort the following sequence (12, 55, 44, 21, 87, 16) using quick sort
3) Write insertion sort algorithm also derive the time complexity of insertion sort in best, average and worst case
4) Illustrate the function of Heapsort on the following array: A={25,57,48,37,12,92,86,33}
5) Explain and write partitioning algorithm for Quick Sort.
6) Write an algorithm for counting sort? Illustrate the operation of counting sort on the following array: A={4, 0, 2, 0, 1, 3, 5, 4, 1, 3, 2, 3}
7) Solve the recurrence relation by substitution method: $T(n)= 2T(n/2) + n$

Section C

1) Sort the following sequence using quick sort {22, 44, 33, 11, 77, 66, 55, 88, 100}
2) Solve the following recurrence:
   a) $T(n) = 4T(n/2) + n^2$
   b) $T(n) = T(n/4) + T(n/2) + n^2$
3) Illustrate the operation of counting sort on the following array: A={6, 0, 2, 0, 1, 3, 4, 6, 1, 3, 2}
4) Solve the recurrence using recursion tree method: $T(n) = 3T(n/4) + cn^2$
5) Solve the recurrence:
   a) $T(n) =2T(n/2) + n^2$

b) T (n) = n + T (n/2) (Given T(1)=1)

6) Sort the following sequence {25, 57, 48, 36, 12, 91, 86, 32} using Quick sort.
7) Solve the following recurrence relation:
   a) $T(n) = T(n-1) + n^4$
   b) $T(n) = T(n/4) + T(n/2) + n^2$
8) Write an algorithm for insertion sort. Find the time complexity of Insertion sort in all cases.
9) Sort the following array using Heap-Sort techniques - 5,8,3,9,2,10,1,35,22
10) Discuss in brief Asymptotic Analysis with best, average & worst case complexities.

UNIT 2

Section A

1) Define Red Black trees and state their application
2) Prove that maximum degree of any node in n node binomial tree is log n
3) Discuss B tree properties in brief
4) Write the properties of B-Trees
5) How insert a node in skip list?
6) Explain left rotation in RB tree
7) Write down the properties of Binomial Heap
8) Describe the properties of Red-Black tree.
9) Explain binomial heap with properties.
10) Write down the properties of binomial tree.
11) Explain Skip list in brief.
12) Define Binomial Heap with example.
13) Write short note on Binary Search Tree.
14) How BFS is differ from DFS.

Section B

1) Show the R-B-Tree that results after successively inserting 10, 9, 8,7,6,5,4,3,2 and 1 into an initially empty Red-Black Tree
2) Explain Insertion operation in Red Black tree with suitable example
3) Discuss the various cases for insertion of key in red-black tree for given sequence of key in an empty red-black tree- {10, 9, 8, 7, 6, 5, 4, 3, 2, 1}
4) How B-tree differs with other tree structures. Insert the following information F,S,Q,K,C,L,H,T,V,W,M,R,N into an empty B-tree with minimum degree 2.
5) Show the results of inserting the keys F, S, Q, K, C, L, H, T, V, W, M, R, N, P, A, B, X, Y, D, Z, E in order into an empty B-tree. Use t=3, where t is the minimum degree of B-tree.
6) What is Fibonacci Heap? Discuss the application of Fibonacci Heap.

Section C

1) Write an algorithm for insertion in Fibonacci Heaps. Also discuss amortized analysis for Extract Min operation in Fibonacci Heaps
2) Explain and write an algorithm for union of two binomial heaps and write its time complexity
3) What is skip list? Explain the Insertion operation in Skip list with suitable example
4) Insert the following list of data items 20, 30, 35, 85, 10, 55, 60, 25, 5, 65, 70, 75, 15, 40, 50, 80, 45 in an empty B-tree. Using minimum degree 't' as 3
5) What are the difference between Binary heap and Binomial Heap? Write down the algorithm for Decrease key operation in Binomial Heap
6) Perform the insertion operation using the keys F, S, Q, K, C, L, H, T, V, W, M, R, N, P, A, B in order into an empty B-tree. Use t=3, where t is the minimum degree of B- tree.
7) Explain any one part of the following: - B-tree - AVL tree - Red-Black tree
8) Explain insertion in Red-Black trees. Show steps for inserting 1,2,3,4,5,6,7,8,9 into an empty RB tree.
9) Write an algorithm for insertion of key in the Red-Black Tree. Discuss the various cases for insertion of key in red-black tree for given sequence of key in an empty red-black tree- 5, 16, 22, 25, 2, 10, 18, 30, 50, 12, 1.

10) Explain and write an algorithm for union of two binomial heaps and also write its time complexity?
11) Define a B-Tree of order m. Explain the searching operation in a B-Tree.
12) Write the properties of Red-Black Tree. Illustrate with an example, how the keys are inserted in an empty red-black tree.

UNIT 3

Section A

1) Explain Divide and conquer approach
2) What do you mean by convex hull?
3) Differentiate between Dynamic programming and Greedy approach.
4) Describe convex hull problem.

Section B

1) Write Breadth First Traversal algorithm for any graph. Derive its time complexity. How time complexity of this is different from Depth First Search.
2) Define minimum spanning tree (MST). Write Prim's algorithm to generate a MST for any given weighted graph
3) Write down the Dijkstra algorithm to solve the single source shortest path problem also write its time complexity
4) Use single source shortest path algorithm for find the optimal solution for given graph. [Graph]
5) Discuss greedy approach to an activity selection problem of scheduling several competing activities. Solve following activity selection problem:
   S = {A1, A2, A3, A4, A5, A6, A7, A8, A9, A10} Si = {1, 2, 3, 4, 7, 8, 9, 9, 11, 12} Fi = {3, 5, 4, 7, 10, 9, 11, 13, 12, 14}
6) Define the terms—LCS, Matrix Chain multiplication & Bellman-Ford algorithm.

Section C

1) Show how to compute transitive closure of a graph using Floyd Warshal algorithm for all pair shortest paths
2) Write & explain Kruskal algorithm to find minimum spanning tree for a graph with suitable example
3) Write down the Dijkstra algorithm to solve the single source shortest path problem also write its time complexity
4) What do you understand by convex hull? Discuss the algorithm to solve the convex hull problem
5) Write and explain the Kruskal algorithm to find the Minimum Spanning Tree of a graph with suitable example
6) What is Knapsack problem? Solve Fractional knapsack problem using greedy programming for the following five items with their weights w = {5, 10, 20, 30, 40} and values P = {30, 20, 100, 90, 160} with knapsack capacity is 60
7) Describe in detail one of the following: - Strassen's Matrix Multiplication algorithm - Karatsuba Multiplication
8) Write short notes on the following:
   1) Graph Coloring
   2) Hamiltonian Cycles
9) Define minimum spanning tree (MST). Write Prim's algorithm to generate a MST for any given weighted graph. Generate MST for the following graph using Prim's algorithm. [Graph provided in image]
10) Explain Dijkstra's algorithm to solve single source shortest path problem with suitable example.
11) Write an algorithm for minimum spanning tree with example
12) Consider a graph G=(V,E). We have to find a Hamiltonian cycle using backtracking method. [Graph]

UNIT 4

Section A

1) How Backtracking approach is different from branch & bound approach?
2) Explain the elements of Dynamic programming
3) Write down the Floyd Warshal algorithm
4) What is Dynamic programming?
5) Differentiate between Dynamic programming and Greedy approach.
6) Define travelling salesman problem in detail.
7) Differentiate between Backtracking and Branch & Bound approach.
8) Differentiate Backtracking algorithm with branch and bound algorithm.

Section B

1) Differentiate between Backtracking and Branch & Bound method? Discuss 0/1 Knapsack problem with respect to Backtracking
2) What is N queens problem? How N queens problem is solved by backtracking
3) Write an algorithm for graph coloring problem. Draw a state space tree for graph coloring problem using backtracking? Let n=4 and m=3
4) Explain any one minimum cost spanning tree algorithm with example.
5) What is sum of subset problem? Draw a state space tree for Sum of subset problem using backtracking? Let n=6, m=30 and w [1:6] = {5, 10, 12, 13, 15, 18}
6) Describe TSP? Show that a TSP can be solved using backtracking method in exponential time.

Section C

1) What is Activity Selection problem? Write a greedy approach to solve Activity Selection problem
2) When and how dynamic programming approach is applicable? Discuss the matrix chain multiplication problem with respect to Dynamic programming
3) Explain the method of finding Hamiltonian cycles in a graph using backtracking method with suitable example
4) Describe the Floyd Warshall algorithm for finding the all pair shortest path problem with suitable example
5) Discuss Travelling Salesman Problem with respect to Dynamic programming technique
6) Discuss Sum of subset problem using Backtracking approach with suitable example
7) Write one algorithm for one of the two binomial heaps. What is its complexity?
8) Consider 5 items along with their respective weights and values: W = {5,10,20,30,40} V = {30,20,100,90,160}, capacity = 60. Find the optimal solution to the Fractional Knapsack problem.
9) Explain the Floyd-Warshall algorithm with an example. Which design strategy does the algorithm use?
10) Write an algorithm for the Sum Subset problem using backtracking approach. Find all subsets for the following instances using the same algorithm: Find all subsets for S={2,5,7,8,10,15,20,25} such that the sum m=30.
11) Consider I={I1,I,2,I3}; W={5,4,3}; V={6,5,4} and W=7, we have to pic this knap-sack using the branch and bound technique.
12) Explain the Floyd Warshall algorithm with an example.
13) Discuss n queen's problem. Solve 4 queen's problem using backtracking method?

14) What is travelling salesman problem (TSP)? Find the solution of following TSP using dynamic programming.

0 1 15 6
2 0 7 3
9 6 0 12
10 4 8 0]

UNIT 5

Section A

1) Discuss randomized algorithm
2) What is NP-Hard problem?
3) Write naive string matching algorithm
4) Solve the recurrence: $T(n)=16T(n/4)+n^2$ by using Master method.
5) Explain Fast Fourier Transform (FFT).
6) Explain Fast Fourier Transform in brief.
7) Write an algorithm for naive string matcher?
8) Define Computational Geometry.

Section B

1) Write Knuth-Morris-Pratt algorithm for string matching. Also discuss its time complexity
2) Explain and Write the Knuth-Morris-Pratt algorithm for pattern matching with suitable example
3) Write the Rabin karp string matching algorithm also write its time complexity
4) Write KMP algorithm for string matching? Perform the KMP algorithm to search the occurrences of the pattern abaab in the text string abbabaabbaab.
5) Write an algorithm of Naïve Matching and implement it by any example.

Section C

1) Discuss:
   a) NP complete problem
   b) Approximation Algorithm
2) Discuss String matching algorithm. Explain naive string-matching algorithm for the text T= abcaabccaabbabca and pattern P= abc
3) Write and Explain Boyer-Moore Algorithm for string matching algorithm
4) Prove that APPROX- VERTEX-COVER is a polynomial time 2-approximation algorithm
5) Write and explain the algorithm to solve set cover problem using approximation algorithm
6) Explain P, NP, NP-Complete and NP-Hard problems in detail
7) Discuss any one string matching algorithm and also find the prefix function for the string "ababaca".
8) Define approximation algorithms. What is approximation ratio? Approximate the traveling salesman problem with triangle inequality.
9) Write short notes on following:
   a) Randomized algorithm.
   b) NP- complete and NP hard.
10) What is approximation algorithm? Explain set cover problem using approximation algorithm.
11) Explain the classes P, NP, NPC and NP hard. How are they related to each other?
12) Write short notes on:
   a) Approximation Algorithms.
   b) Randomized Algorithms.